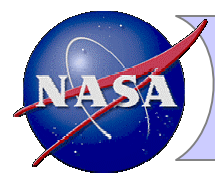


# NASA Direct Readout

- Providing Science Direct Readout  
Mission Continuity to the Broad User  
Community -

Patrick Coronado  
NASA / GSFC/ 935  
Direct Readout Group



# Who We Are

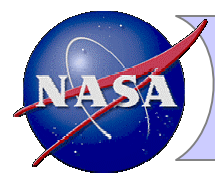


## **The Direct Readout Group (DRG)**

The Direct Readout Group designs, develops, integrates and tests technologies that enable validation and testing of satellite and instrument specific hardware, decoding software, data processing and management systems necessary to acquire and process NASA's directly broadcasted space-borne and airborne instrument data. Under this directive we endeavor to:

- Provide all necessary hardware and software technologies, knowledge, information and lessons learned to the general public through technology transfer and public domain releases.
- Serve as a guide to the commercial sector on the utility of Earth remote sensing satellites and its instruments.
- Provide cost saving solutions for the acquisition, processing and distribution of Earth remote sensing directly broadcasted data.

The Direct Readout Group supports several NASA missions and collaborates with other government agencies, universities and the commercial sector to execute the above directive.



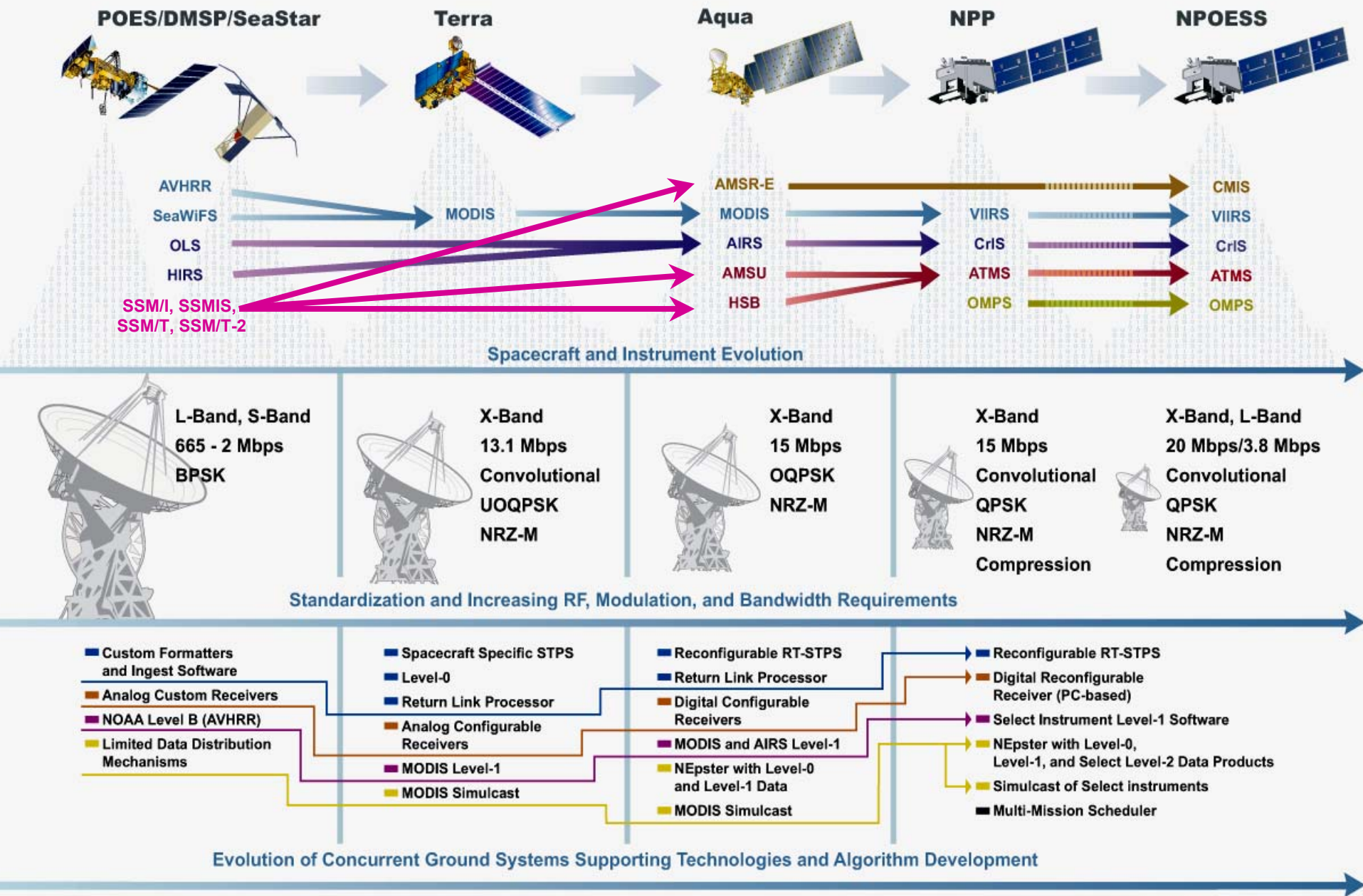
# What We Do

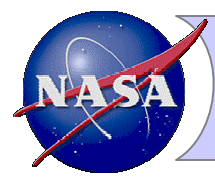


- Provide spacecraft Direct Broadcast RF configuration and data encoding designs
  - Provide trade-off analysis for bandwidth optimization promoting DB continuity while meeting enhanced performance requirements of new missions.
  - Provide risk reduction for future missions.
- Develop prototype upgrades to existing DB receiving capabilities which will enable users to receive and process NASA-specific instrument data
  - System modules have backward-compatibility to receive and pre-process legacy data.
  - Prototype design technology is transferred to the private sector for commercialization; DB users purchase system upgrades directly from commercial sources.
- Deliver algorithm support tools that contain instrument-specific formats, parameters, configurations and information.
- Provide Direct Broadcast-converted geo-registration and calibration (Level-1/SDR) algorithms for select instruments.
- Provide select Level-2/EDR DR science algorithms implementations
- Provide end-to-end testing of the spacecraft's DB link to ensure compatibility with existing DB ground systems.
- Develop a Commercialization and Technology Transfer Plan for each technology and science algorithm.
- Provide and stage all technologies, algorithms and supporting data sets for distribution to the DB user community

All to achieve one Goal....

# Ensuring Direct Broadcast Continuity

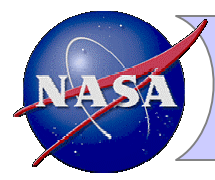




# How We Do It



- We have a working model that allows the DRG to efficiently interact with both the DB user community and NASA's mission.
  - Allows us to understand what continuity means to the public and how to minimize their impact
  - Allows for focused technology and algorithm development
- Established a web portal for **controlled** technology, algorithm, information and data release to the public



# DRG DB User Model

## - NPP Example -



### Internal Mission Team

#### NPP MISSION

- Protocol/Data Interface Compatibility
- Spacecraft I&T for Direct Broadcast
- Direct Broadcast Level-0 and Level-1 Algorithms and Verification
- Working Group Meetings
- System Meetings
- Science Team Meetings

Report  
the  
State  
of the  
Community

#### NISGS

Provide a  
Roadmap  
to  
Future  
Technology

### External Direct Broadcast Community

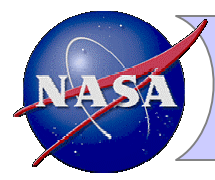
- Frequently Asked Questions
- Email
- Technology Transfer
- Technology Enabling
- Public Release Software
- Web Portal Feedback
- Open-door Policy
- Demonstrations
- Presentations
- Conferences

**R&D  
Organizations**

**General  
Public**

**Commercial  
Sector**

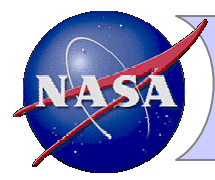
**Other  
Government  
Agencies**



# Bridging EOS and NPOESS



- DRG supports this transition by guiding the EOS and POES DB community through tools and algorithms necessary to acquire and process NPP instrument data
- And as a continuation from work started for EOS missions the DRG provides:
  - Porting of select NASA Institutional algorithms to Direct Broadcast
  - Instrument data format definitions to the DB community
  - S/C Direct Broadcast RF characterization and troubleshooting
  - Base-band instrument data stream decoders – raw to Level-0
  - S/C Ephemeris and Attitude conversion algorithms
  - End-to-end testing of Direct Broadcast S/C to ground RF and DB data processing algorithms



# DB Tools and Algorithms



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## Element

- **Real-Time Software Telemetry Processing System (RT-STPS)**
- **Ground-Based Attitude Determination (GBAD) module**
- **Simulcast**
- **Multi-Mission Scheduler and Dispatcher**

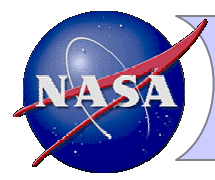
## Rationale

**Required for separation and pre-processing of all instrument data from downlink stream through Level-0 (RDR)**

**S/C Attitude and Ephemeris reformatting. Required as a pre-processing step to Level-1 processing (SDR)**

**Remote real-time quality and verification monitoring of all instrument data streams**

**System module required for scheduling and dispatching real-time NISGS front-end functions**



# DB Tools and Algorithms (cont.)



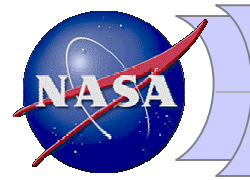
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## Element

## Rationale

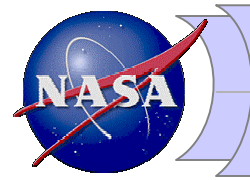
- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>• <b>standalone Instrument Level-1 (SDR) and select Level-2 (EDR) algorithms</b></li></ul>                        | <p><b>Would provide standalone calibration and geo-registration for instruments. Level-2 output would provide a basis for system tool and level-1 validation and continuity of from EOS DB science processing</b></p> |
| <ul style="list-style-type: none"><li>• <b>HRD S4P Implementation</b></li></ul>   | <p><b>Data driven processing scripts to control all algorithms, meta-data, ancillary data and tools. Required for process control and monitoring.</b></p>   |
| <ul style="list-style-type: none"><li>• <b>Instrument-specific Level-1 (SDR) and select L-2 (EDR) visualization and data formatting tools</b></li></ul> | <p><b>Required for quality control monitoring and establishing a baseline for valid science product visualization and exchange</b></p>  |
| <ul style="list-style-type: none"><li>• <b>Public Release and Tech Transfer</b></li></ul>   | <p><b>Methods and procedures for release of NASA Technology</b></p>   |
| <ul style="list-style-type: none"><li>• <b>NEpster</b></li></ul>  | <p><b>A vehicle to allow DB users to exchange data in near-real-time</b></p>  |



# Design Objectives



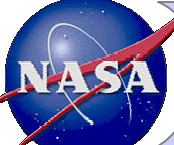
- Develop a Direct Readout technology suite that are free to “anyone”
- Key design criteria are:
  - Scalability
  - Extensibility
  - Portability
  - Ease of Use
- These “individual” enabling technologies will be tested within a functional system environment, the NISGS
  - Including verification with NPP spacecraft prior to launch



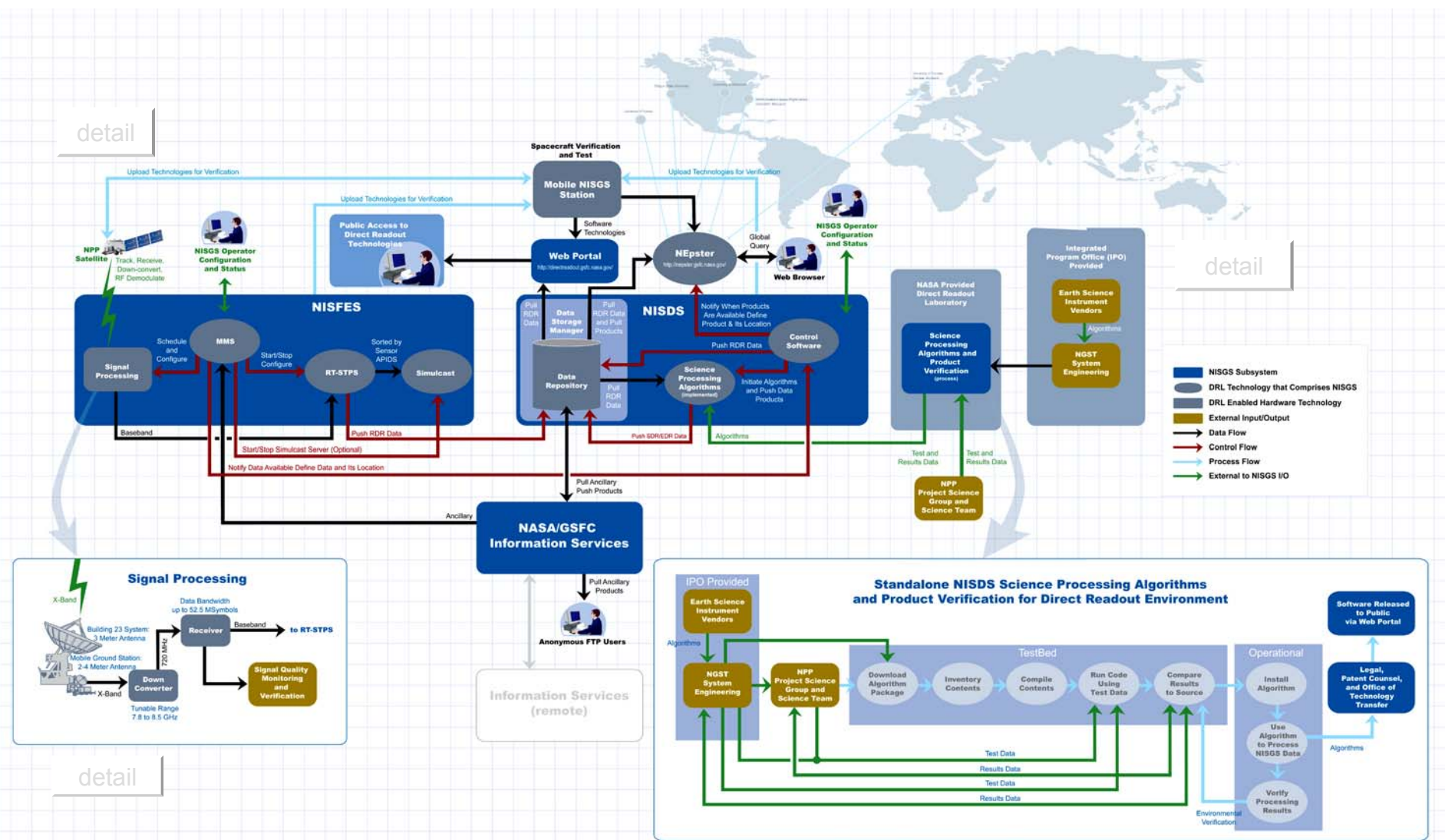
# What is NISGS ?

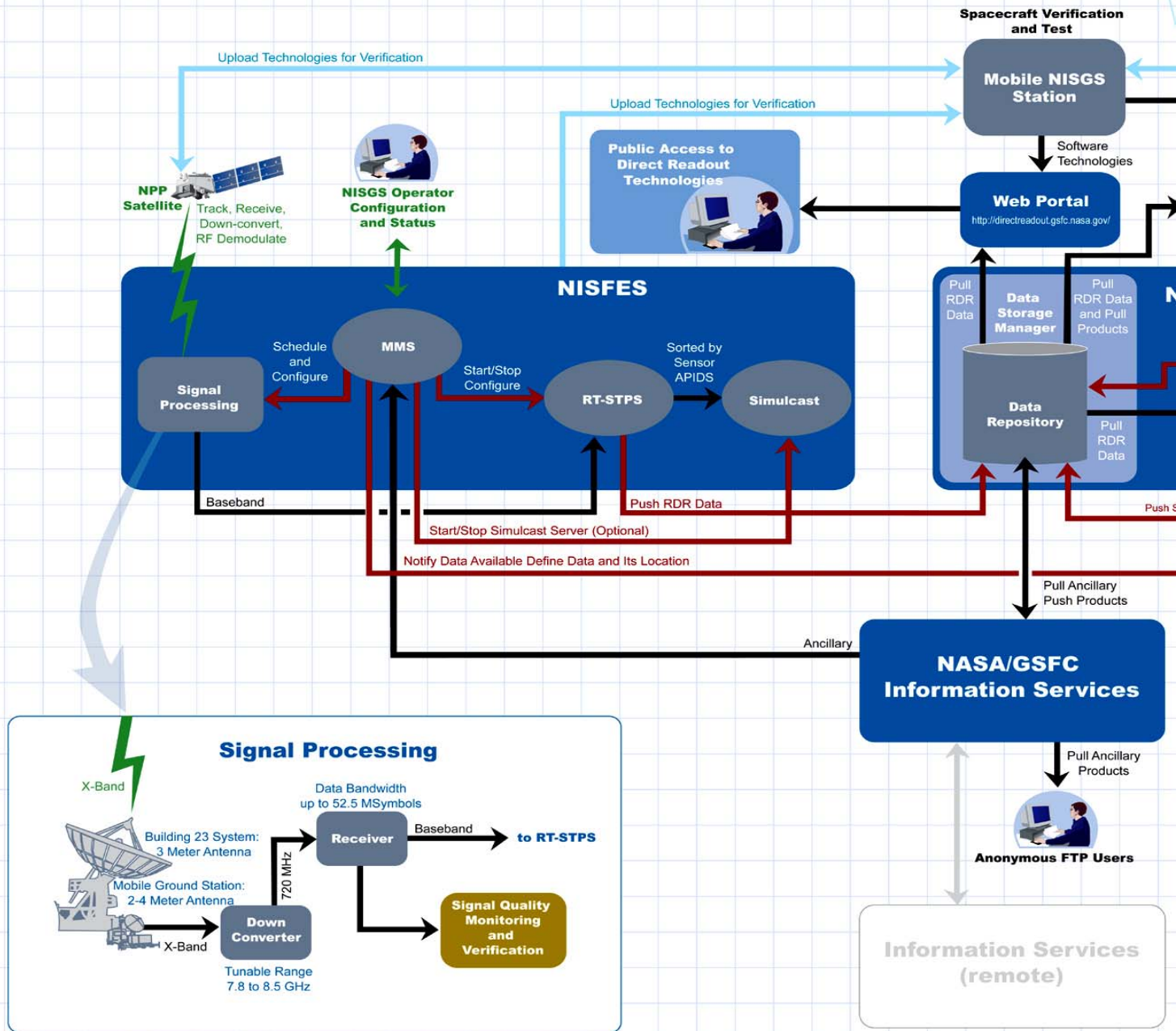
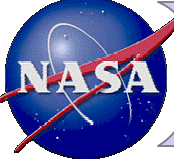


- The NPP In-Situ Ground System (NISGS) is an Element of the NPOESS Preparatory Project (NPP)
- NISGS directly supports the NASA Technology Insertion and NPOESS Risk Reduction objectives of NPP as well as the EOS Data Continuity :
  - Provides technology insertion for NPOESS, which will assure that the NPOESS High Rate Data (HRD) design will be readily usable by the existing EOS DB community.
  - Enables the extensive EOS Direct Broadcast (DB) user community to readily transition from existing POES/Terra/Aqua DB data to NPP and NPOESS HRD data.

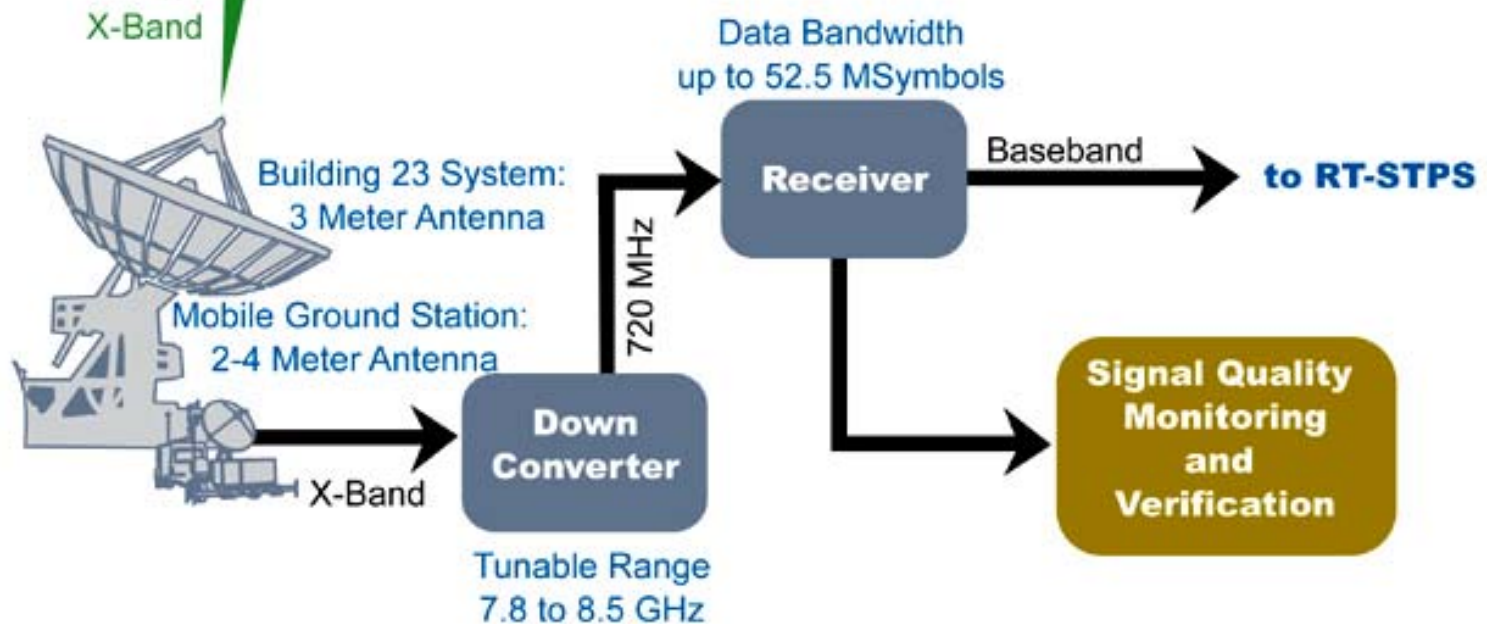


# NISGS Architecture Test-bed Model

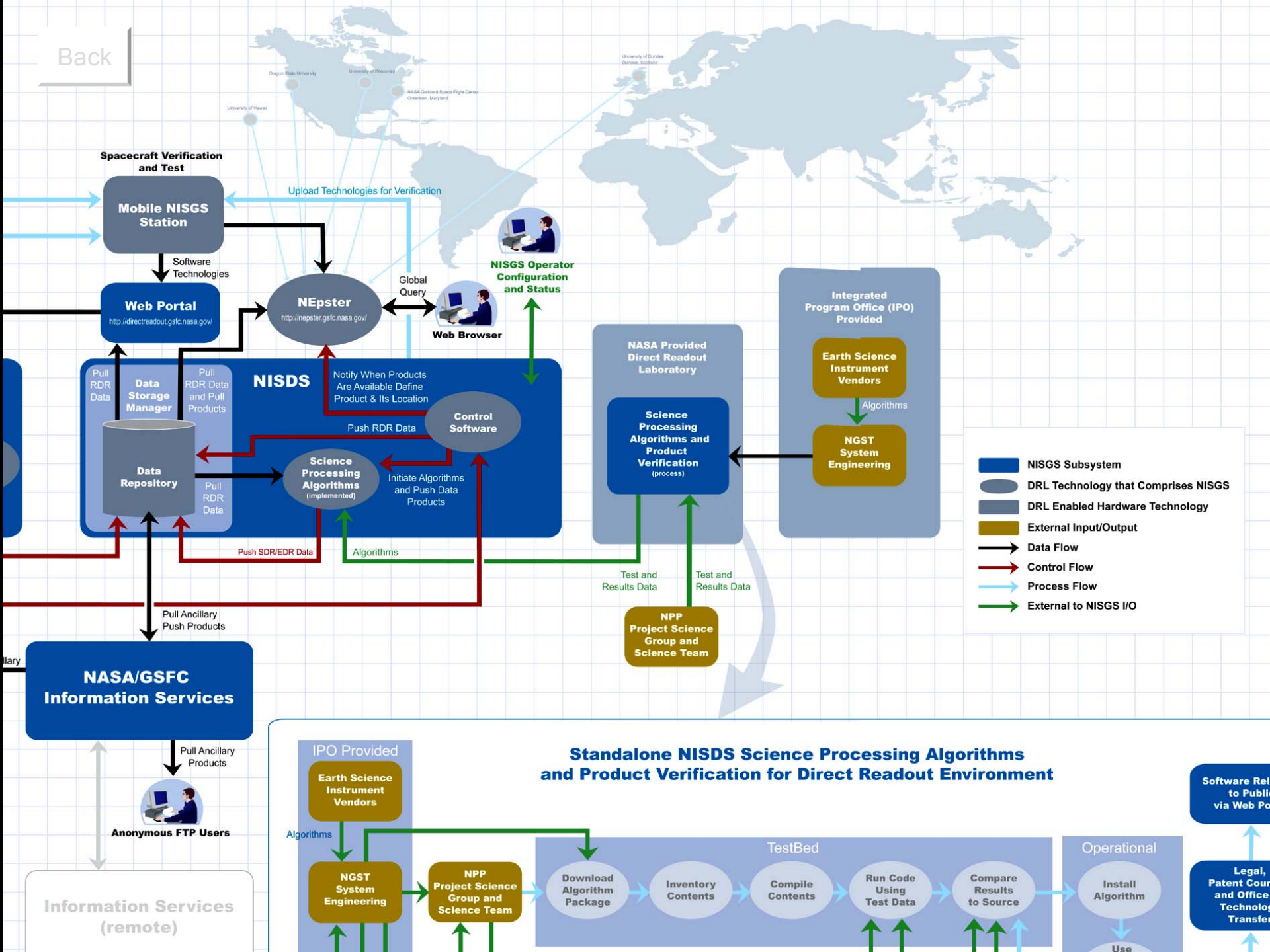


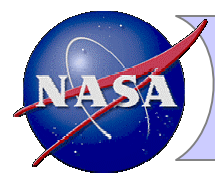


## Signal Processing

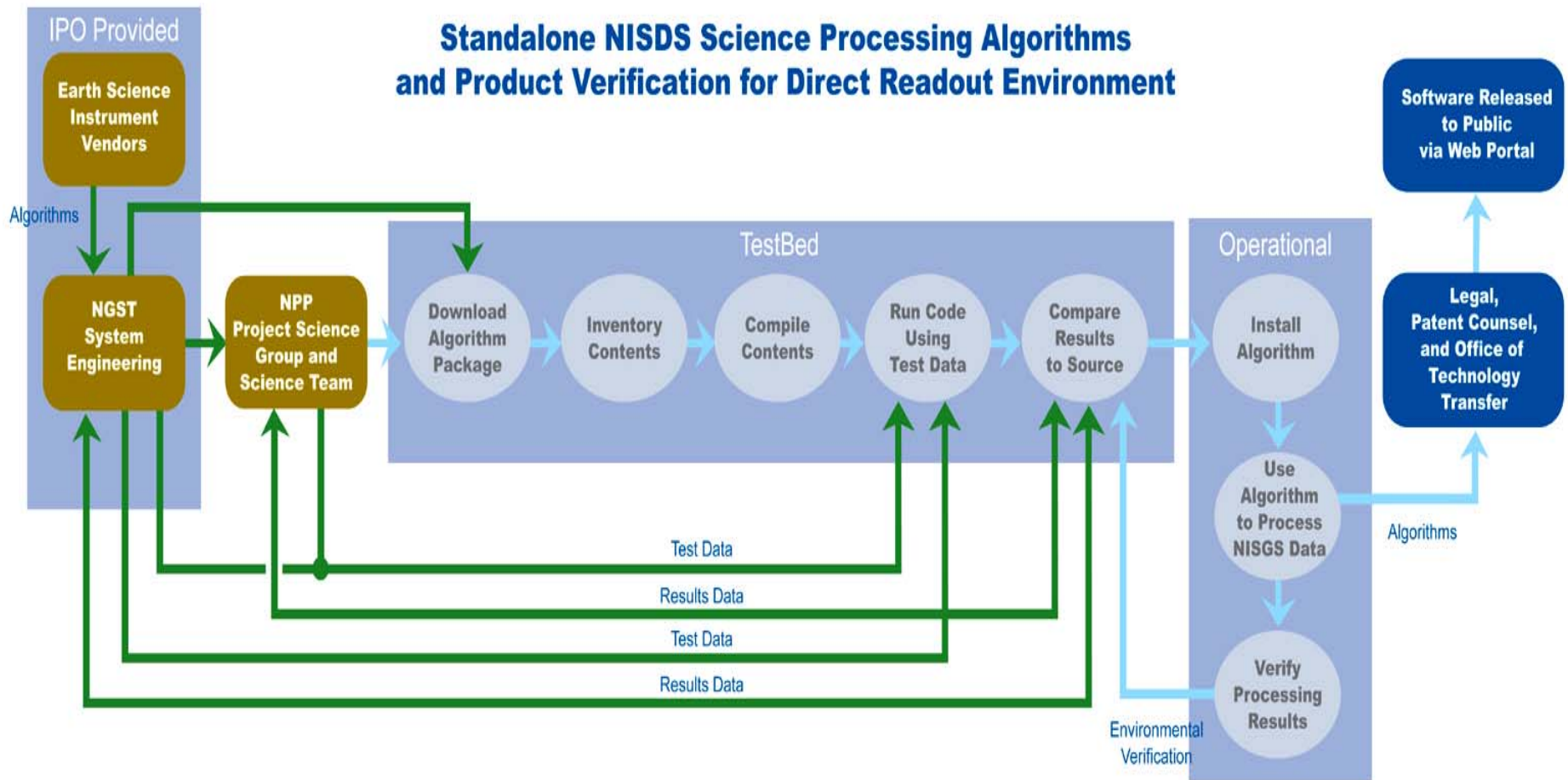


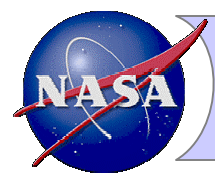
[Back](#)



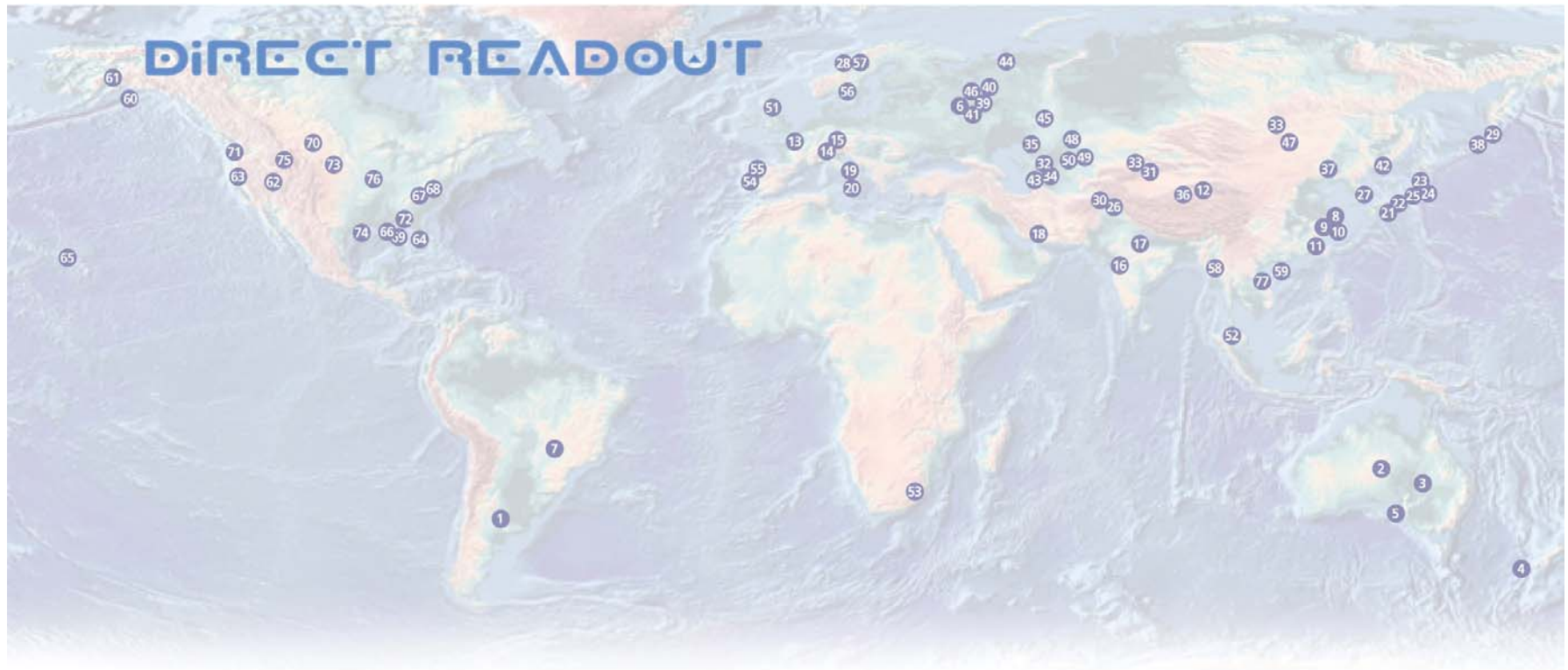


## Standalone NISDS Science Processing Algorithms and Product Verification for Direct Readout Environment

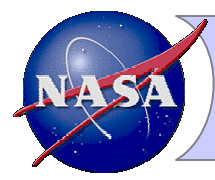




# Present EOS DR Ingest Sites



- Over 100 Ingest sites around the world for Terra/Aqua DB downlink
- Over 1000 Users of data extending from 100 ingest sites
- List is located on the Direct Readout Portal



# Direct Readout Web Portal

<http://directreadout.gsfc.nasa.gov>



A staging area for instrument-specific algorithm, information and technology

The Direct Readout Portal - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media

Address <http://directreadout.gsfc.nasa.gov/index.html> Go Links

## DIRECT READOUT PORTAL

TECHNOLOGY DEVELOPMENT MISSION SUPPORT DOWNLOAD DATA DOWNLOAD TECHNOLOGY PORTAL INFO LINKS CONTACT US

### Hot Links

MODIS  
Latest MODIS Image

Data  
Global DB Data

Missions  
NPP  
Aqua  
Terra

Technology  
DB Software  
Inst. Algorithms

Links  
Documentation  
Overpass Predictor  
Ephemeris

## Welcome to the Direct Readout Portal

This portal provides the Direct Readout (DR) community with easy access to Earth remote sensing data and technologies through shared information resources.

We achieve this by:

- 1) Providing mission-specific information and free technologies to acquire and process Direct Broadcast Data;
- 2) Introducing the user community to Direct Readout Systems Technologies;
- 3) Providing users with a design template to receive, process and analyze their own Direct Readout Data.

### DB Technology for the Future

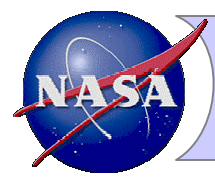


[What is Direct Broadcast \(DB\)?](#)

[What is Direct Readout \(DR\)?](#)

[How can I acquire and process my own DB Terra/Aqua data?](#)

Internet



# DRG Contact Info



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The Direct Readout Web Portal:

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